Savannah River Site
Solid Waste Management Department
Consolidated Incinerator Facility
Operator Training Program

SOLID WASTE FEED SYSTEM (U)

Study Guide

ZIOITX02

Revision 01

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Training Manager / Date

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Engineering / Date

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Facility Manager / Date

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REVISION LOG

REV.	AFFECTED SECTION(S)	SUMMARY OF CHANGE
01	All	New Issue

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REFERENCES

1. 261-AOP-SWF-01, *Ram Feed and Gate Events,* Rev. 1

2. 261-SOP-SWF-01, *Solid Waste Feed Operations*, Rev. 6-D

3. DOE Order 4330.4B, *Conduct of Maintenance,* Chapter 6

4. J-SD-H-00004, *Savannah River Site Consolidated Incineration Facility Functional Description, Container Handling,* Rev. 0

5. SRP 03000, *Savannah River Project Box Handling Facility,* Rev. 5

6. W835589, *Power, Service, PPG & Instrument Diagram Ram/Solid Feed,* Sheet 2, Rev. 18

7. WSRC-SA-17, *Savannah River Site Consolidated Incineration Facility, Safety Analysis Report*, DOE Approval Copy

8. WSRC-8Q, *Employee Safety Manual*

9. ZIOISX02, *Savannah River Site Solid Waste Training System Design Description, Solid Waste Feed,* Rev. 0

LEARNING OBJECTIVES

TERMINAL OBJECTIVE

1.0 Without references, **EXPLAIN** the significance of the Solid Waste Feed System to Consolidated Incinerator Facility operations and the impact on operations of a failure of the system.

ENABLING LEARNING OBJECTIVES

1.1 **STATE** the purpose of the Solid Waste Feed System.

1.2 Briefly **DESCRIBE** how the Solid Waste Feed System accomplishes it's intended purpose.

1.3 Briefly **EXPLAIN** the consequences of a failure of the Solid Waste Feed System to fulfill it's intended purpose, including the effects on other systems or components and overall plant operation.

TERMINAL OBJECTIVE

2.0 Using system diagrams, **EVALUATE** potential problems which could interfere with normal Solid Waste Feed System flowpaths to determine their significance on overall system operation and the corrective actions needed to return the system to normal.

ENABLING LEARNING OBJECTIVES

2.1 **DESCRIBE** the physical layout of the Solid Waste Feed System components including, the general location and functional relationship for each of the following major components:

a. Box Pusher Gate and Conveyor
b. Box Pusher Ram and Housing
c. Feed Ram Gate
d. Kiln Feed Ram and Housing
e. Kiln Feed Fire Door
f. Hydraulic Unit

2.2 **DESCRIBE** the Solid Waste Handling Feed arrangement to include a drawing showing the following system components and interfaces with other systems:

a. Box Pusher Gate and Conveyor

b. Box Pusher Ram and Housing
c. Feed Ram Gate
d. Kiln Feed Ram and Housing
e. Kiln Feed Fire Door
f. Hydraulic Unit

2.3 Given a description of abnormal equipment status for the Solid Waste Feed System, **EXPLAIN** the significance of the condition on system operation.

2.4 Given applicable procedures and a description of the Solid Waste Feed System equipment status, **STATE** any corrective actions required to return system operation to a normal condition.

TERMINAL OBJECTIVE

3.0 Given values of Solid Waste Feed System operation parameters, **EVALUATE** potential problems that could effect the normal functioning of the system or it's components to determine the significance of the existing condition and the actions required to return the system to normal operation.

ENABLING LEARNING OBJECTIVES

3.1 **DESCRIBE** the following major components of the Solid Waste Handling System including their functions, principles of operation, and basic construction:

a. Box Pusher Gate and Conveyor
b. Box Pusher Ram and Housing
c. Feed Ram Gate
d. Kiln Feed Ram and Housing
e. Kiln Feed Fire Door
f. Hydraulic Unit
g. Power Supplies

3.2 **STATE** the design capacities and operational limitations for the following Solid Waste Handling System major components:

a. Box Pusher Gate and Conveyor
b. Box Pusher Ram and Housing
c. Feed Ram Gate
d. Kiln Feed Ram and Housing
e. Kiln Feed Fire Door
f. Hydraulic Unit

3.3 **DESCRIBE** the following Solid Waste Feed System instrumentation including, indicator location (local or Control Room), sensing points, and associated instrument controls.

a. Ram Solid Feed Hydraulic Control Panel
b. Photoelectric eyes
c. Flame Scanner
d. Temperature Sensors
e. Hydraulic Plant Instrumentation

3.4 **INTERPRET** the following Solid Waste Feed System alarms, including the conditions causing alarm actuation, automatic functions, and likely causes for the alarms:

a. High Hydraulic Fluid Temperature
b. Low Hydraulic Fluid Pressure
c. High Hydraulic Fluid Pressure
d. Low Purge Flow
e. High Ram Housing Temperature
f. Flame in Feed Ram Enclosure
g. Low Feed Ram Housing Pressure
h. High Box Pusher Housing Pressure
i. Nitrogen Snuffing Pressure Low
j. Bottled Nitrogen Pressure Low

3.5 **EXPLAIN** how the following Solid Waste Feed System equipment is controlled in automatic or manual mode to include: control locations (local or Control Room), basic operating principles of control devices, and the effects of each control on the component operation.

a. Box Pusher Gate and Conveyor
b. Box Pusher Ram and Housing
c. Feed Ram Gate
d. Kiln Feed Ram and Housing
e. Kiln Feed Fire Door
f. Hydraulic Unit

3.6 **DESCRIBE** the interlocks associated with the following Solid Waste Feed System equipment to include the interlock actuating conditions, effects of interlock actuation, and the reason the interlock is necessary.

TERMINAL OBJECTIVE

4.0 Given necessary procedures or other technical documents and system conditions, **DETERMINE** the operator actions required for normal and off normal operation of the Solid Waste Feed System including problem recognition and resolution.

ENABLING LEARNING OBJECTIVES

4.1 **STATE** the personnel safety concerns associated with the Solid Waste Feed System.

4.2 Given applicable procedures, **DETERMINE** the effects on the Solid Waste Feed System and the operator response when given either of the following:

a. Indications/alarms

b. Malfunctions/failure of components

4.3 Given applicable procedures and plant conditions, **DETERMINE** the actions necessary to perform the following Solid Waste Feed System operations:

a. Startup

b. Manual Operation of Equipment

c. Shutdown

SYSTEM OVERVIEW

Introduction

The Consolidated Incineration Facility (CIF) receives solid waste in the form of 21 inch cubed cardboard containers from various locations on site. The contents of the containers are comprised of various paper, cloth, and plastic materials which average 25 pounds per container. Upon delivery, the containers are examined for compatibility with incineration in the Solid Waste Handling (SWH) System. Those containers meeting specific requirements are then routed to the Solid Waste Feed (SWF) System. The SWF System is used to deliver containers to the incinerator Rotary Kiln (RK) in a batch sequence while maintaining an air-tight seal between the incinerator and the atmosphere. The seal prevents the release of combustion gases from the incineration process into the atmosphere. Solid wastes are fed to the RK using a conveyor and hydraulic feed ram system which are controlled by the Distributive Control System (DCS). The particulates in suspension travel through the RK to the Secondary Combustion Chamber (SCC).

ELO 1. 1 STATE the purpose of the Solid Waste Feed System

SYSTEM PURPOSE

Solid Waste Feed System Purpose

The Solid Waste Feed System is used to deliver containers to the Rotary Kiln(RK) incinerator in batch sequence while maintaining an airtight seal between the incinerator and the atmosphere.

SOLID FEED FLOW DIAGRAM

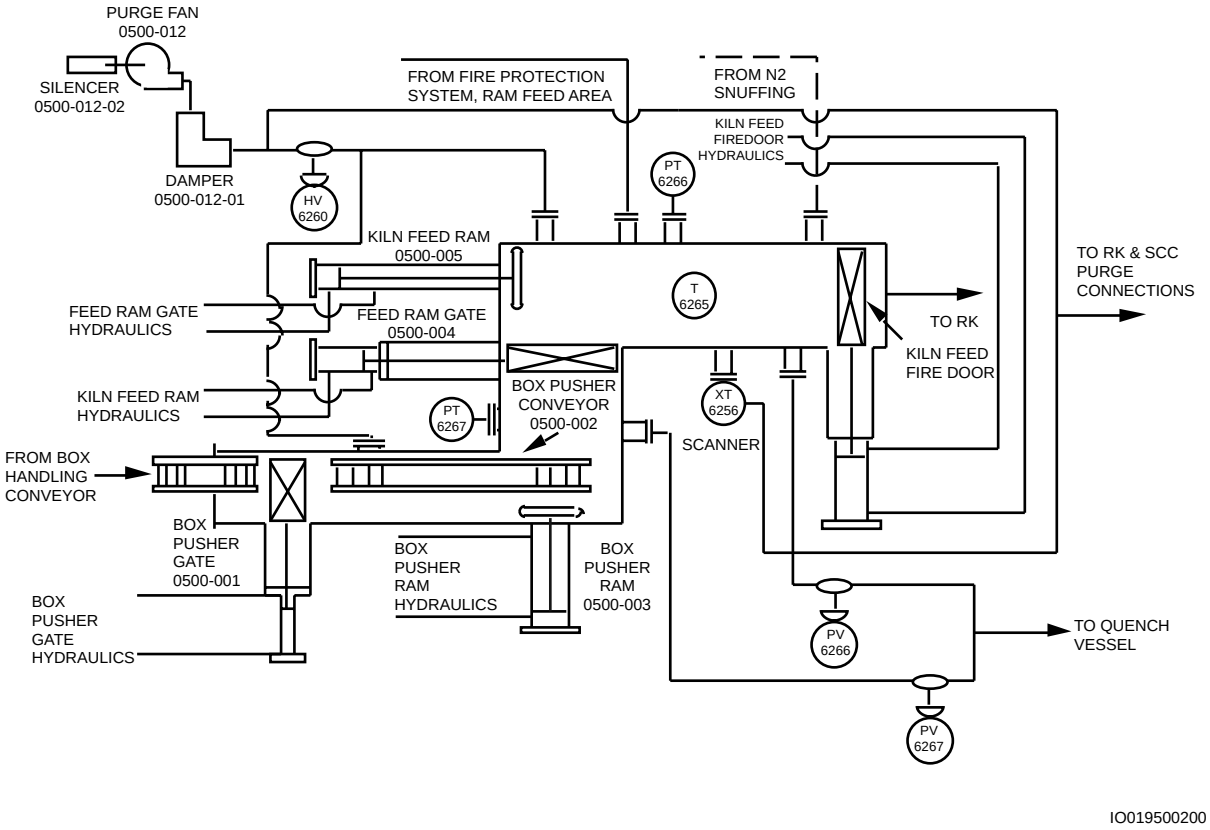

Figure 1 Solid Waste Feed System

DESCRIPTION AND FLOWPATH

ELO 1.2	**Briefly DESCRIBE how the Solid Waste Feed System accomplishes it's intended purpose.**

System Description

Solid waste is delivered from the SWH System in DCS controlled batches. A batch, normally consisting of 1 to 3 boxes, is discharged from the box lift and sent through a series of gates and rams that are operated in sequence. The operational sequencing is controlled to prevent release of combustion gases, unburned or residual wastes, or contaminants from the SWF housings or kiln to the atmosphere. The SWF System also has safety devices and controls for fire suppression, emergency feed, and feed rate.

ELO 2.1	**DESCRIBE the physical layout of the Solid Waste Feed System components including, the general location and functional relationship for each of the following major components:** **a. Box Pusher Gate and Conveyor** **b. Box Pusher Ram and Housing** **c. Feed Ram Gate** **d. Kiln Feed Ram and Housing** **e. Kiln Feed Fire Door** **f. Hydraulic System**

System Flowpath

(See Figure 2 Solid Waste Feed System) The conveyors and controls in the SWH System will deliver the containers to a box lift that moves the boxes from ground level to incinerator level. The box lift is comprised of a vertical lift (movable) conveyor and a stationary conveyor. The containers are fed by the movable conveyor across to the stationary conveyor, through the box pusher gate and then onto the box pusher conveyor. The box pusher conveyor delivers the containers to the box pusher ram, which pushes the containers laterally through the feed ram gate. The kiln feed ram then pushes the containers into the kiln through the kiln feed fire door.

The gates are tight fitting and sealed to prevent air leakage and to maintain a negative pressure differential relative to the atmosphere when they are closed. The seals are an inflatable type which are pressed up with compressed air and deflated prior to operation. This prevents leakage of combustion gases from the housings into the atmosphere.

Hydraulic Fluid Flowpath

The hydraulic fluid in the reservoir gravity flows to the suction side of the two tandem driven hydraulic pumps. (See Figure 3 Solid Waste Feed Hydraulic System) Pump #2 supplies fluid to

the Box Pusher Ram, Box Pusher Gate, Feed Ram Gate, Kiln Feed Ram, and the Kiln Feed Fire Door. Pump #1 delivers hydraulic fluid to three accumulators. Accumulators store pressurized hydraulic fluid. The accumulators can supply enough pressurized hydraulic fluid to allow for one cycle of operation of the kiln feed ram and the Kiln Feed Fire Door in the event of a hydraulic system pump failure.

Fluid supply to the components is controlled by dedicated valves (FV-2003, 2004, 2006, 2007 and 2008) which cycle to operate the rams, gates and the firedoor. A manually adjustable pressure control valve is also used to maintain pressure 600 pounds per square inch gauge pressure (psig). There are also solenoid-operated control valves in the supply headers from pump #2 and from the accumulators to the control valves for the components.

Fluid in the return lines is routed through a shell and tube-type heat exchanger before being returned to the reservoir. Process water is used as the heat transfer medium in the heat exchanger. The Process Water supply is controlled by a solenoid-operated flow control valve.

Instrument Air Flowpath

Instrument Air is provided for the Box Pusher Gate and Feed Ram Gate inflatable seals. The instrument air flows through pressure control valves to reduce the working pressure to 30 psig and then through solenoid-operated flow control valves. The seals are inflated when the gates are closed. Prior to opening the gates, the instrument air supply to the seals is isolated and the seal air is removed by using a Venturi type vacuum pump to ensure that the seal is deflated which prevents abrasion on a partially deflated seal.

Summary

1. SWF System accepts boxes in controlled batches of 1-3 boxes and delivers the batch to the Rotary Kiln (RK) through a series of gates and rams.
2. Operational sequencing of the gates, gate seals, and housing pressure prevent release of gases, wastes, or contaminants.
3. Hydraulic power for the gates and rams is delivered by pumps with installed accumulators for emergency operation.
4. Instrument Air is supplied to inflatable seals for the Box Pusher Gate and Ram Feed Gate.

Review Questions

1. What is the purpose of the Solid Waste Feed System?
2. Briefly describe the sequence of events for a batch of boxes moving through the SWF system.
3. What is supplied by hydraulic pump #1? hydraulic pump #2?
4. What can be operated and how many times by the hydraulic accumulators?
5. What system provides cooling for the hydraulic fluid? What component provides cooling?
6. What 3 features **of the system** prevent release of gases, wastes or contaminants?

7. Draw a basic block diagram of the SWF system showing major components and connections to other systems.
8. What is used to deflate the gate seals and why are they deflated?

2.2	**DESCRIBE the Solid Waste Handling Feed arrangement to include a drawing showing the following system components and interfaces with other systems:** **a. Box Pusher Gate and Conveyor** **b. Box Pusher Ram and Housing** **c. Feed Ram Gate** **d. Kiln Feed Ram and Housing**

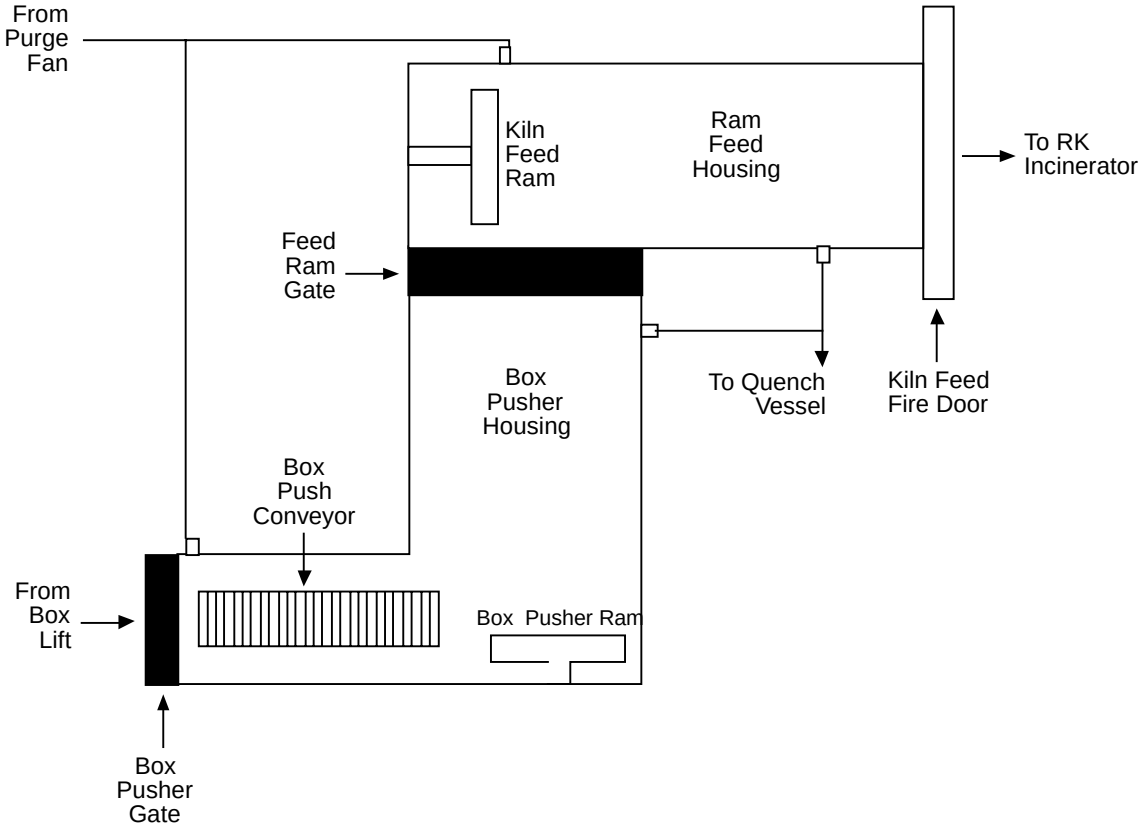

Figure 2 Block Diagram of Solid Waste Feed System

MAJOR COMPONENTS

ELO 3.1	**DESCRIBE the following major components of the Solid Waste Handling System including their functions, principles of operation, and basic construction:** **a. Box Pusher Gate and Conveyor** **b. Box Pusher Ram and Housing** **c. Feed Ram Gate** **d. Kiln Feed Ram and Housing** **e. Kiln Feed Fire Door** **f. Hydraulic Unit** **g. Power Supplies**
ELO 3.2	**STATE the design capacities and operational limitations for the following Solid Waste Handling System major components:** **a. Box Pusher Gate and Conveyor** **b. Box Pusher Ram and Housing** **c. Feed Ram Gate** **d. Kiln Feed Ram and Housing** **e. Kiln Feed Fire Door** **f. Hydraulic Unit**

Box Pusher Gate (H-261-SWF-GATE-001)

A box pusher gate is provided at the inlet to the incinerator SWF Box Pusher housing. The gate is 26" X 26" and capable of passing a 21 inch cube box with a minimum clearance of five inches between the top and two and one half inch between the sides of the box and frame of the gate. The gate is tight fitting to prevent air leakage and to allow the box pusher housing to be maintained at a negative pressure relative to atmosphere when closed. Hydraulic cylinders are provided to open the gate when boxes are to be received from the box lift conveyor and to close the gate when boxes are completely inside the box pusher housing. The gate is equipped with an inflatable seal to prevent air leakage into the housing. The seal is automatically deflated before the gate is opened and it is automatically reinflated (using instrument air) after the gate is closed.

Box Pusher Conveyor (H-261-SWF-CONV-001)

Boxes are discharged from the motor-driven box lift conveyor (as discussed in the Solid Waste Handling module), through the opened box pusher gate, and onto the box pusher conveyor. The box pusher conveyor is a motorized chain driven roller conveyor used to move the boxes into the box pusher housing. It is energized when the box pusher gate is open and boxes are on the box

lift conveyor.

Box Pusher Ram (H-261-SWF-FDR-001) and Housing

The hydraulic box pusher ram is designed to push 1 to 3 boxes simultaneously off the box pusher conveyor into the incinerator feed ram housing. The box pusher ram is actuated by two hydraulic cylinders mounted one on top of the other with their rods extending in opposite directions. The box pusher housing is gas tight with the only connection to the atmosphere being the box pusher gate at the inlet. The housing encloses the box pusher conveyor and the box pusher ram, and connects to the feed ram housing via the feed ram gate at the outlet. The box pusher housing is purged with air continuously by the purge blower and maintained under vacuum by a connection to the quench vessel. The purge prevents a buildup of combustible gases and the vacuum ensures that any leakage is into the housing. A pressure control valve is provided in the exhaust line to maintain the line under a constant vacuum (-0.25"WC). The Purge Air and Quench System are described in detail in ZIOITX17, Offgas System.

Feed Ram Gate (H-261-SWF-GATE-002)

The hydraulic feed ram gate is similar in construction to the box pusher gate and is sized to pass up to three 21 inch cubed boxes, side by side, into the feed ram housing. The gate is equipped with an inflatable seal to prevent air leakage into the housing. The seal is automatically deflated before the gate is opened and it is automatically reinflated (using instrument air) after the gate is closed. The feed ram gate, box pusher gate and the box pusher housing form an airlock between the room atmosphere and the inside of the feed ram housing.

Kiln Feed Ram Housing

The kiln feed ram housing is constructed of carbon steel with an abrasion-resistant alloy steel floor. Internal dimensions are 26 inches by 26 inches in cross section by a length sufficient to hold three 21 inch cubed boxes with the feed ram retracted and the fire door closed. The Feed Ram Housing is continuously purged with air from the purge air blower and it is maintained under a vacuum by a connection to the quench vessel. The purge prevents a buildup of combustible gases and ensures that any air leakage is into the housing. A pressure control valve is provided in the exhaust line to maintain the line under a constant vacuum (-0.25"WC).

Kiln Feed Ram (H-261-SWF-FDR-002)

The kiln feed ram is actuated by two hydraulic cylinders mounted one on top of the other with their rods extending in opposite directions (same as the box pusher ram). This arrangement provides a relatively compact means for moving the feed ram the approximate 12-1/2' required to insure that all boxes are pushed into the incinerator. The time required for the fire door to cycle is approximately 50 seconds. When the fire door has closed, the ram then fully retracts to receive the next charge of boxes. The ram has adequate clearance to provide for thermal expansion when exposed to incinerator temperatures.

Kiln Feed Fire Door (H-261-SWF-GATE-003)

The fire door is 37" by 37". The door is constructed of carbon steel with a 6" refractory lining. The door is hydraulically operated and sequenced in operation with the feed ram gate and box pusher gates to ensure that only one gate or door is open at any one time. The door is sequenced with the kiln feed ram to allow feed into the incinerator.

Hydraulic Unit

(See Figure 4 Solid Waste Feed Hydraulic Diagram) The hydraulic power unit has a 60 gallon oil reservoir that includes two tandem (driven by the same shaft) pumps, a heat exchanger, three accumulators (See Figure 3 Basic Accumulator Diagram) and the associated piping and valves. The three hydraulic accumulators provide adequate fluid and pressure to operate the kiln feed ram and fire door through one cycle in the event of a hydraulic pump failure. The hydraulic accumulators are maintained charged by Hydraulic Pump #1, which shares a common motor with Hydraulic Pump #2. Design pressure for the hydraulic system is 1000 psig with an operating pressure of approximately 600 psig. The hydraulic fluid is a fire-resistant type that will function efficiently in the temperature range of 20-120 degrees Fahrenheit (°F). The hydraulic fluid is cooled by the Process Water System through a heat exchanger.

Power Supplies

SWF System power supply is from 480V Motor Control Centers (MCCs) 2 and 4. MCC 2 provides power to the incinerator box lift conveyor. MCC 4 provides power to the box pusher conveyor and to the hydraulic unit.

Summary

1. The Box Pusher Gate is 26” by 26” opening with a tight fitting gate. An inflatable seal is deflated prior to opening and reinfated when shut.
2. The Box Pusher Conveyor is a motorized chain driven roller conveyor which moves boxes into the Box Pusher Housing.
3. The Box Pusher Ram pushes 1-3 boxes off box pusher conveyor through Ram Feed Gate into the incinerator ram feed housing.. The Box Pusher housing is maintained under vacuum by connection to the quench system and is continuously purged by the purge blower.
4. The Feed Ram Gate is a tight fitting gate with an inflatable seal. It is sized to pass up to 3 boxes side by side into the Kiln Feed Ram Housing.
5. The Kiln Feed Ram is hydraulically operated and moves the boxes 12 1/2 feet into the incinerator through the Kiln Feed Fire Door.
6. The Kiln Feed Fire Door is 37” by 37” and constructed of carbon steel with 6” refractory lining. The door is sequenced with the Kiln Feed Ram to allow feed into the incinerator.

HYDRAULIC UNIT FLOW DIAGRAM

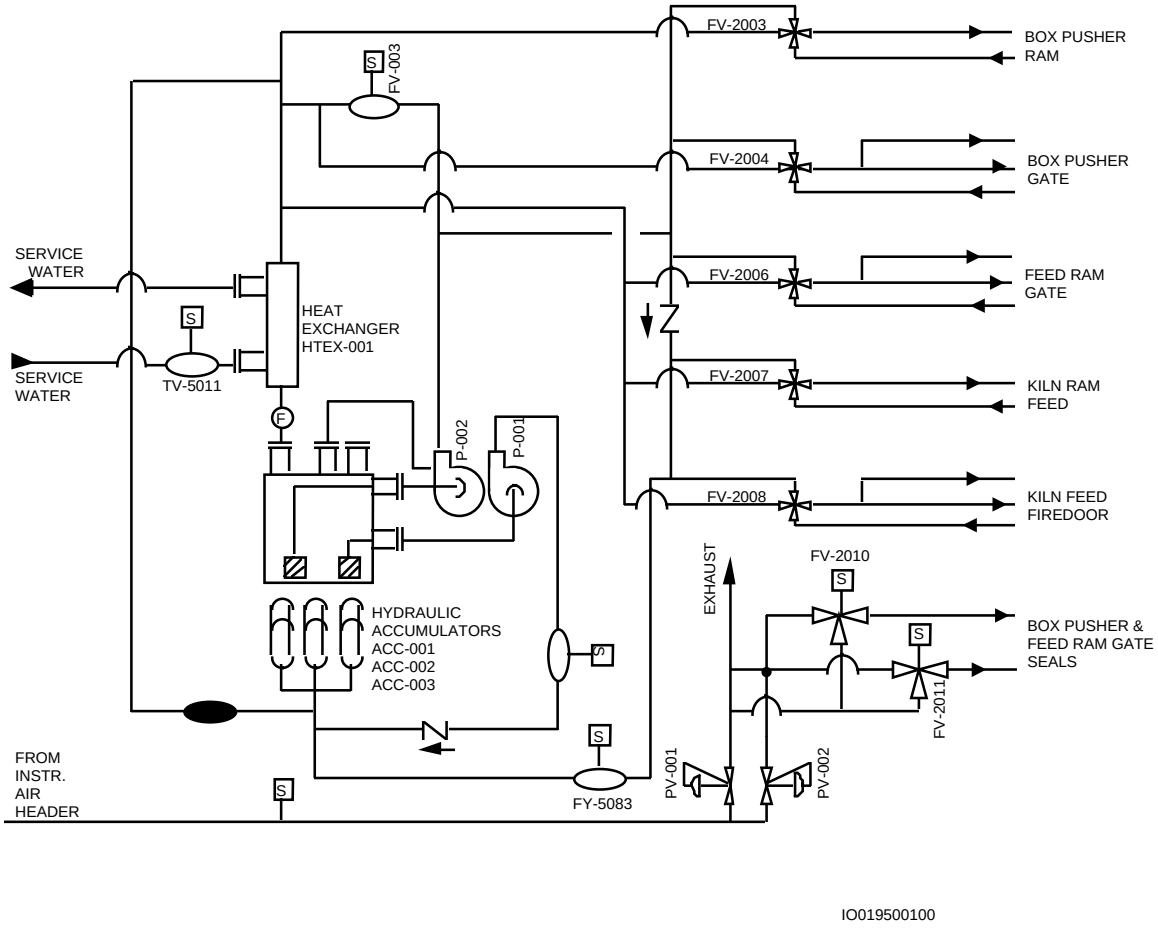

Figure 3 Solid Waste Feed Hydraulic System

Review Questions

1. What is the size of the opening for the Box Pusher Gate? What 2 features of the gate prevent air leakage past the gate?
2. How does the Box Pusher Gate seal function in sequence with the gate? How is this accomplished?
3. Describe the type and purpose of the Box Lift Conveyor.
4. How does the Box Pusher housing features prevent the buildup of gases and leakage to the atmosphere?
5. Why does the Feed Ram Gate differ in size from the Box Pusher Gate?
6. How are hydraulic pumps #1 and #2 arranged in the hydraulic plant?
7. What are the power supplies for the Solid Waste Feed System components?
8. Describe the construction and operation of the Kiln Feed Ram.

INSTRUMENTATION

ELO 3.4	**DESCRIBE the following Solid Waste Feed System instrumentation including, indicator location (local or Control Room), sensing points, and associated instrument controls.** **a. Ram Solid Feed Hydraulic Control Panel** **b. Photoelectric eyes** **c. Flame Scanner** **d. Temperature Sensors** **e. Hydraulic Plant Instrumentation**

Ram Solid Feed Hydraulic Control Panel

A local push-button station is provided to allow the operator to control the SWF System. Selector switches and push-buttons are provided for actuation of hydraulic cylinders, conveyor operation, fire suppression system operation, and system stop and emergency stop.

Indications at the local control station include the following:

- CONTROL POWER ON (white indicating light) - power available to panel from electrical distribution system
- KILN FEED FIRE DOOR OPEN (white indicating light) - limit switch H-261-SWF-ZS-6254-(A) at upper end of door vertical travel made
- KILN FEED FIRE DOOR CLOSED (red indicating light) - limit switch H-261-SWF-ZS-6354-(B) at lower end of door vertical travel made
- FLAME DETECTED IN RAM FEED CHAMBER (red indicating light) - sensed by scanner H-261-SWF-BE-6256 which signals Programmable Logic Controller (PLC)
- HYDRAULIC UNIT TEMPERATURE (digital indicator) - temperature signal from temperature element (6205T)
- HYDRAULIC MANIFOLD PRESSURE (digital indicator) - accumulator pressure signal from pressure transmitter (6207PT)
- Fire Alarm (audible alarm) - local alarm (6356XA) at 300°F generated by scanner BE-6256 which signals PLC; alarm also registers on DCS

Figure 3, Ram Solid Feed Hyd. Control Panel, shows the layout of the indications.

Photoelectric Eyes

Conveyors and gates in the system are equipped with photoelectric eyes. The purposes of the eyes are to sense boxes on the conveyors in order to, initiate or prevent conveyor operation when required, control box lift operation, and to cycle isolation gates.

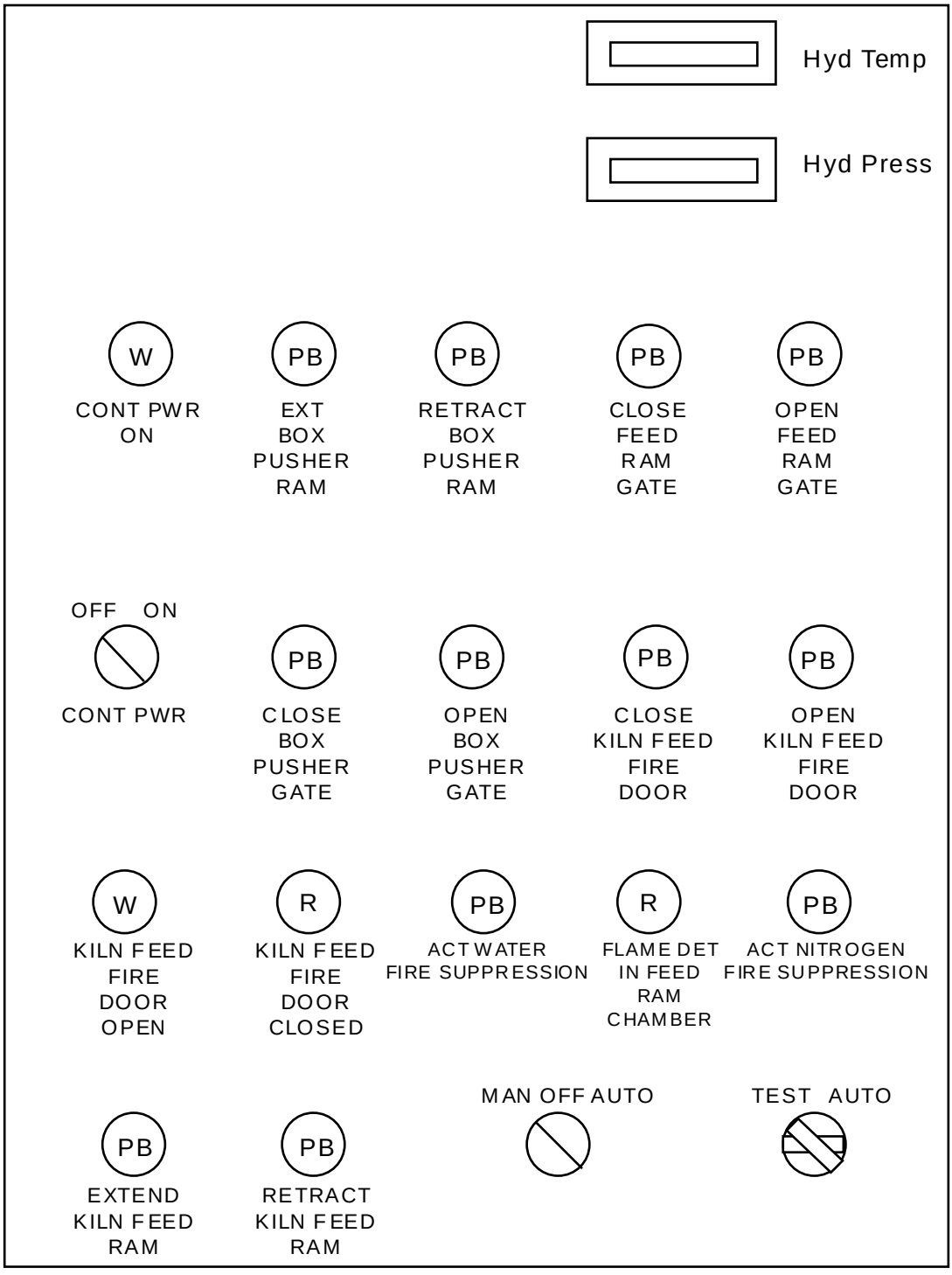

Figure 4 SWF Hydraulic Control Panel

Flame Scanner and Temperature Sensors

The feed ram housing includes a flame scanner and temperature sensors at it's discharge end. The flame scanner and temperature sensors are used to detect any fire in the housing. A signal from the flame scanner provides DCS indication and a local audible alarm to alert the operator to activate the nitrogen snuffing fire suppression system. Nitrogen is provided by six portable nitrogen bottles stationed outside the building at ground level. The Nitrogen System is discussed in ZIOITX19, Air and Nitrogen Systems. The Fire Protection System is discussed in more detail in ZIOITX21, Fire Protection System.

Limit Switches

Limit Switches provide positioning limits and control hydraulic functions for most Solid Waste Feed System components. These functions include gate travel (open and closed) and ram travel (extended and retracted). See individual component controls for a detailed description of component limit switch identification and function.

Hydraulic Plant

Hydraulic Plant instrumentation includes a level detector for the hydraulic sump (H-261-SWF-LSL-6209), local sightglass for the hydraulic sump, temperature detector for the sump(H-261-SWF-TE-6205), pressure detector at the discharge of #2 hydraulic pump (H-261-SWF-PT-6207), and a pressure detector for the accumulators (H-261-SWF-PSL-6211).

Summary

1. The Ram Feed Hydraulic Control Panel is a local push-button station for control of the SWF system and the hydraulic plant. It has push-button controls , indicating lights, and instruments for use and information of the local operator.
2. Photoelectric eyes are used to sense box alignment, initiate conveyor operation, control box lift operation, and to cycle isolation gates.
3. Flame Scanner and temperature sensors are used to detect any fire in the housing.
4. Hydraulic Plant instrumentation provides instrumentation for temperature, level, and pressure detection.

Review Questions

1. What are the available **indications** provided on the Ram Solid Feed Hydraulic Control Panel?
2. What 3 control functions are provided in part by the Photo Electric Eyes of the SWF system?
3. How is a fire in the Ram Feed Housing detected and what is used to suppress the fire?

CONTROLS, INTERLOCKS AND ALARMS

ELO 3.7	**DESCRIBE the interlocks associated with the following Solid Waste Feed System equipment to include the interlock actuating conditions, effects of interlock actuation, and the reason the interlock is necessary.**

SWF Gate, Door and Ram DCS Control

The SWF System doors, gates and rams are equipped with position switches to indicate if doors and gates are open or closed or if rams are fully extended or retracted. The position switches provide signals to the DCS. The DCS will also receive pressure indications from the Box Pusher housing, Feed Ram housing and the RK. Interlocks are provided to prevent opening the doors and gates unless the area downstream of the gate/door is at a lower pressure (more negative relative to atmospheric pressure) than the upstream area. The pressures through the SWF and Incineration Systems are as follows:

- Room pressure - 0.05"WC
- SWF housings - 0.25"WC (small difference between housings)
- Rotary Kiln -0.5"WC
- Quench vessel - 2.0"WC

Based upon these inputs, the DCS will control the positioning of the gates, doors and rams as necessary to deliver the mass flow feed rate as selected by the operator. Sequencing and control of the doors, gates and rams are as follows:

Box Pusher Gate

Operation is initiated by the PLC. Interlocks prevent opening the gate unless both the Feed Ram Gate and Kiln Feed Fire Door are closed. The gate will not open unless the Box Pusher Ram is in the retracted position as per limit switch H-261-SWF-ZS-6251-(A). Gate travel in the upward direction is stopped at the upper limit by limit switch H-261-SWF-ZS-6250-(A). Gate travel in the downward direction is stopped at the lower limit by the limit switch H-261-SWF-ZS-6250-(B). Gate position as signaled by the limit switch output is displayed on DCS.

Box Pusher Conveyor

Operation is initiated by the PLC. Interlock prevents starting the conveyor unless the Box Pusher Gate is open. Boxes move into housing until they reach positive stop and limit switch H-261-SWF-ZS-6255 and five second timer has elapsed. A photoelectric scanner, H-261-SWF-PEC-6258, is also provided on the inlet to the gate to indicate when all boxes are cleared.

Box Pusher Ram

Operation is initiated by the PLC. Interlock prevents moving the Box Pusher Ram in the extended position unless Feed Ram Gate is open as per limit switch H-261-SWF-ZS-6252-(A) and the Box Pusher Gate is closed as per limit switch H-261-SWF-ZS-6250-(B). Ram fully extended position indicated as per limit switch H-261-SWF-ZS-6251-(B). Ram is in the retracted position as per limit switch H-261-SWF-ZS-6251-(A). The Ram also has a limit switch, H-261-SWF-ZS-6251-(C), for indication when it is in the Intermediate position. Ram position as signaled by the limit switch output is displayed on DCS.

Feed Ram Gate

Operation is initiated by the PLC. Interlocks prevent opening the gate unless both the Box Pusher Gate and Kiln Feed Fire Door are closed. Gate will not open unless Ram Feeder is in fully retracted position as per limit switch H-261-SWF-ZS-6253-(A). Gate travel in the upward direction is stopped at the upper limit by limit switch H-261-SWF-ZS-6252-(A). Gate travel in the downward direction is stopped at the lower limit by the limit switch H-261-SWF-ZS-6252-(B). Gate position as signaled by the limit switch output is displayed on DCS. The gate remains open approximately 26 seconds for the box charge to be positioned.

Kiln Feed Ram

Operation is initiated by the PLC. Interlock prevents moving the Feed Ram towards the kiln unless the Kiln Feed Fire Door is open as per limit switch H-261-SWF-ZS-6254-(A) and the Feed Ram Gate is closed as per limit switch H-261-SWF-ZS-6252-(B). Ram fully extended position indicated as per limit switch H-261-SWF-ZS-6253-(B). Ram is in the retracted position as per limit switch H-261-SWF-ZS-6553-(A). The Ram also has a limit switch, H-261-SWF-ZS-6253-(C), for indication when it is in the Intermediate position. Ram position as signaled by the limit switch output is displayed on DCS.

Kiln Feed Fire Door

Operation is initiated by the PLC. Interlock prevents opening the Fire Door unless the Box Pusher Gate and the Feed Ram Gate are closed. Gate will not open unless Ram Feeder is in fully retracted position as per limit switch H-261-SWF-ZS-6253-(A). Gate travel in the upward direction is stopped at the upper limit by limit switch H-261-SWF-ZS-6254-(A). Gate travel in the downward direction is stopped at the lower limit by the limit switch H-261-SWF-ZS-6254-(B). Gate position as signaled by the limit switch output is displayed on DCS. If the Fire Door remains open for five minutes or longer, it will cause an automatic incinerator shutdown.

Mass Feed Rate

The solids feed control is based on mass flow rate. The maximum allowable weight of one box

or one batch of boxes is 75 pounds with the expected average weight of a single box being approximately 25 pounds. A batch of one to three boxes will be assembled in the SWH System so as to match the operator-selected mass flow rate but not to exceed the maximum design weight of 95 pounds. A desired mass feed rate is set into the DCS by the operator (900 lbm/hr is the maximum rate). Each box of solid waste is weighed and inspected in the Solid Waste Handling System with that information being used by DCS for determination of the current feed rate. If this rate is below the operator-selected mass flow rate, the charging frequency is increased by reducing the dwell period for boxes waiting to enter the box pusher gate. If the current rate is above the set feed rate, the DCS will increase the dwell period. The dwell period is defined as the programmed delay period that a box remains in one position or at one component in the system.

Flame Scanner or High Temperature

The Feed Ram Housing includes a flame scanner and temperature indicator near the discharge end to sense any fire in the housing. A signal from the flame scanner H-261-SWF-BE-6256 signals the PLC. An alarm on DCS, 6256XA, and an audible alarm at the local control panel will alert the operators. Input from the flame scanner will cause CIF Incinerator Shutdown, the Purge Air Control Valve H-261-PRGA-6260 to close to limit air flow to the fire., and H-261-SWF-GATE-002 RAM Feed Gate Closes. A temperature element, H-261-SWF-TE-6265, is located in the Feed Ram Housing. It inputs to a temperature switch, H-261-SWF-TT-6265, which will signal a high temperature condition on the DCS at a temperature of 300°F. Probable Causes are a fire in the Feed Ram Housing or a flame detector malfunction.

Hydraulic Unit Control

A local Manual-Off-Automatic (MOA) Selector switch is provided for operation of the Hydraulic Unit.

ELO 3.6	**EXPLAIN how the following Solid Waste Feed System equipment is controlled in automatic or manual mode to include: control locations (local or Control Room), basic operating principles of control devices, and the effects of each control on the component operation.** **a. Box Pusher Gate and Conveyor** **b. Box Pusher Ram and Housing** **c. Feed Ram Gate** **d. Kiln Feed Ram and Housing** **e. Kiln Feed Fire Door** **f. Hydraulic Unit**

Ram Solid Feed Hydraulic Control Panel

A local control station is provided to allow the operator to control the Solid Waste Feed System.

Selector switches and push-buttons are provided for actuation of hydraulic cylinders, conveyor operation, fire suppression system operation, and system stop and emergency stop.

The MAN (Manual)-Off-AUTO (Automatic) (MOA) selector switch is positioned in the AUTO position at system startup to allow DCS/PLC control and operation. Placing the selector in MANUAL allows the operator to operate the system control valves with local push-buttons and selectors.

The TEST/AUTO (Automatic) selector switch is normally operated in the AUTO position which allows control functions in accordance with the position of the MOA selector switch. When the switch is placed in the TEST position, it allows operation of control valves for maintenance and periodic surveillances. Testing may be performed when the facility is in a shutdown mode or if the facility is in a standby mode where operation of incinerator support systems is not required. Test operation may not be performed if the incinerator is in operation or if the DCS has initiated a startup sequence.

Push-button controllers on the panel include EXTEND BOX PUSHER RAM, RETRACT BOX PUSHER RAM, OPEN FEED RAM GATE, CLOSE FEED RAM GATE, OPEN BOX PUSHER GATE, CLOSE BOX PUSHER GATE, OPEN KILN FEED FIRE DOOR, CLOSE KILN FEED FIRE DOOR, EXTEND KILN FEED RAM and RETRACT KILN FEED RAM. Operations are interlocked with component positioning per limit switches as previously mentioned. Push-button operation is only permitted when MOA selector is in MAN position.

The push-button controller ACTIVATE NITROGEN FIRE SUPPRESSION SYSTEM is operated locally at the push-button station. It may be operated with the MOA selector switch in either the AUTO or MAN positions.

Figure 4, Ram Solid Feed Hyd. Control Panel, shows the layout of the controls.

Box Lift

The box lift has a maintenance door at ground level to permit access for maintenance and servicing. The door at ground level is equipped with a safety interlock to prevent casual entry. Any attempted entry while the system is in operation will energize the DOOR OPEN signal on the DCS which will sound an alarm and stop the feed process.

DCS Inputs for SWF Shutdown

- The SWF System is automatically shut down by the DCS based on any of the following inputs:
- Box Pusher or Feed Ram failure (input from position switch or interlocks)
- Hydraulic pressure is above or below specified limits
- Hydraulic accumulator pressure is below specified limit
- Nitrogen snuffing pressure is below specified limit

CLI Number	DCS Point Tag Display	Description	DCS Alarm Setpoint
H-261-SWF-TAHH-6205	SWF6205T-1	Hydraulic Fluid Temp HI HI	160 °F
H-261-SWF-TSH-6205	SWF6205T-1	Hydraulic Fluid Temp HI	140 F
H-261-SWF-PAL-6207	SWF6207P-1	Hydraulic Pressure Low	5 PSIG
H-261-SWF-PAH-6207	SWF6207P-1	Hydraulic Pressure HI	650 PSIG
H-261-SWF-PAL-6211	SWF6211PA	Accumulator Pressure Low	50 PSIG
H-261-SWF-LA-6209	SWF6209LA-1	Hydraulic Fluid Level Low	BY VENDR
H-261-PRGA-FAL-6261	SWF6259E-1	Purge Flow Low	200 SCFM
H-261-SWF-TSHH-6265-(B)	SWF6265TS-2	Ram Feed Housing Temp High High High	500 F
H-261-SWF-TAHH-6265-(A)	SWF6265TS-1	Ram Feed Housing Temperature High High	300 F
H-261-SWF-TAH-6265	SWF6265TS	Ram Feed Housing Temperature High	180 °F
H-261-SWF-BSH-6256		Flame in Feed Ram Enclosure	Flame
H-261-SWF-PAL-6266	SWF6266PC-1	Ram Feed Housing Pressure Low	-0.5 INWC
H-261-SWF-PAH-6267	SWF6267PC-1	Box Pusher Housing Pressure High	+0.1 INWC
H-261-FP-PAL-2105	FP2105-1	Nitrogen Snuffing Pressure Low	5 PSIG
H-261-FP-PAL-2101	FP2105-1	Bottled Nitrogen Pressure Low	350 PSIG

- **Table 1 SWF System Alarm Setpoints**
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- Photoelectric eye detects a box stuck beneath Box Pusher Gate
- Flame scanner detects flame in the Feed Ram Housing
- Temperature indicator detects high housing temperature
- Ash Removal System failure on DCS
- Incinerator or Secondary Combustion Chamber (SCC) exit temperature drops below LO-LO-LO Setpoint

DCS Alarm Setpoints: See Table 1

ELO 3.5	**INTERPRET the following Solid Waste Feed System alarms, including the conditions causing alarm actuation, automatic functions, and likely causes for the alarms:** **a. High Hydraulic Fluid Temperature** **b. Low Hydraulic Fluid Pressure** **c. High Hydraulic Fluid Pressure** **d. Low Purge Flow** **e. High Ram Housing Temperature** **f. Flame in Feed Ram Enclosure** **g. Low Feed Ram Housing Pressure** **h. High Box Pusher Housing Pressure** **i. Nitrogen Snuffing Pressure Low** **j. Bottled Nitrogen Pressure Low**
ELO 4.2	**Given applicable procedures, DETERMINE the effects on the Solid Waste Feed System and the operator response when given either of the following:** **a. Indications/alarms** **b. Malfunctions/failure of components**

Alarms

Flame in Ram Feed Enclosure

A flame in the Ram Feed Enclosure is detected by flame sensor H-261-SWF-BSH-6265 and displayed on the DCS point tag display SWF6265-1. An alarm will cause incinerator shutdown, H-261-SWF-GATE-002 closes and H-261-SWF-PRGA-FCD-6260 RAM Enclosure Purge Air Flow Control Damper closes. An alarm light is also located on the Ram Solid Feed Hydraulic Control Panel. Most probable causes are a fire in the housing or a flame detector malfunction. Actions should be taken as per ARP-SWF6256XA.

Low Purge Flow

Low Purge Flow is detected by H-261-SWF-PRGA-FS-6261 and indicated on the DCS point

tag display SWF6259E-1. Setpoint is 200 SCFM. Automatic functions include a shutdown of the incinerator. Most likely causes are a Purge Air Fan malfunction, a damper malfunction, fire in the Ram Feed Housing, or a flow transmitter malfunction. Actions should be taken as per ARP-SWF6261FA.

High Ram Feed Housing Temperature

A high Ram Feed Housing Temperature is detected by H-261-SWF-TSH-6265 and is indicated on the DCS point tag display SWF6265T-1. Setpoint is 300 F. Automatic functions include a SWF shutdown. Most likely causes are the Kiln Feed Fire Door failed to close, fire in the Ram Feed Housing, inadequate purge air flow, or a temperature transmitter malfunction. Actions should be taken as per ARP-SWF6265TA.

Low Ram Feed Housing Pressure

Low Ram Feed Housing pressure is detected by H-261-SWF-PSL-6266 and is indicated on the DCS point tag display SWF6266PC-1. Setpoint is -0.5 INWC. Automatic functions include a SWF system shutdown. Most likely causes are inadequate purge air flow, improper valve alignment, Off-gas System pressure low, or a pressure transmitter malfunction. Actions should be taken as per ARP-SWF-6266PA.

High Ram Feed Housing Pressure

High Ram Feed Housing pressure is detected by H-261-SWF-PSH-6267 and is indicated on the DCS point tag display SWF6267PC-1. Setpoint is 1.0 INWC. Automatic functions include a SWF system shutdown. Most likely causes are low purge air flow out of housing, excessive purge air supply flow, off-gas system pressure high, or a pressure transmitter malfunction. Actions should be taken as per ARP-SWF6267PA.

HI HI Hydraulic Fluid Temperature

Hi Hi Hydraulic Fluid Temperature is detected by H-261-SWF-TSHH-6205 and is indicated on the DCS point tag display SWF6205T-1. Setpoint is 160 F. There are no automatic functions associated with this alarm. Most likely caused are inadequate Service Water flow to the heat exchanger, high Service Water supply temperature, damaged or plugged heat exchanger, low hydraulic fluid level, temperature sensor malfunction, or improper valve alignment. Actions should be taken as per ARP-SWF6205TA.

Low Hydraulic Pressure

Low Hydraulic Pressure is detected by H-261-SWF-PSL-6207 and is indicated on the DCS point tag display SWF6207P-1. Setpoint is 5.0 PSIG. Automatic functions of this alarm include a shutdown of the Solid Waste Feed System. Most likely causes are Hydraulic Pump #1 malfunction, low hydraulic fluid level, pressure transmitter malfunction, or improper valve line-up. Actions should be taken as per ARP-SWF6207-PA.

High Hydraulic Pressure

High Hydraulic Pressure is detected by H-261-SWF-PSH-6207 and is indicated on the DCS point tag display SWF6207P-1. Setpoint is 650 PSIG . Automatic functions of this alarm include a shutdown of the Solid Waste Feed System. Most likely causes are SWF-FV-6218 failed closed, inoperable pressure transmitter, or a high filter differential pressure. Actions should be taken per ARP-SWF-6207PA-1.

Low Hydraulic Fluid Level

Low Hydraulic Fluid Level is detected by H-261-SWF-LSL-6209 and is indicated on the DCS point tag display SWF6209LA-1. The setpoint is fixed by the vendor. There are no automatic functions associated with this alarm. Most likely causes are a leak or rupture in the hydraulic system. Actions should be taken per ARP-SWF-6209LA.

Low Accumulator Pressure

Low Hydraulic System accumulator pressure is detected by H-261-SWF-PSL-6211 and is indicated on the DCS point tag display SWF6211PA. The setpoint is 50 PSIG. Automatic functions of this alarm include Solid Waste Feed System shutdown. Most likely causes are a leak or rupture in the hydraulic lines or fittings, or an abnormally high use of hydraulic fluid. Actions should be taken as per ARP-SWF6211PA.

Summary

1. Position switches provide indications to DCS of the position of doors, gates, and rams.
2. Pressure detectors, temperature detectors, and a flame scanner provide indications and inputs on conditions inside the housing areas.
3. A series of interlocks are provided to control gate and ram movement to maintain isolation capabilities, maintain housing negative pressure, and prevent damage to the components.
4. Operation of the gates and rams are initiated by the PLC using switches and scanners to sequence movement.
5. Solid feed control is based on mass flow rate which is selected by the operator within the maximum design rate.
6. Alarms provide some automatic control functions and provide indication for use with the ARP's to correct the alarming condition.

Review Questions

1. What are 4 interlocks which must be met to allow the Box Pusher Gate to open?
2. What prevents damage to the Feed Ram Gate by the Box Pusher Ram?
3. In general, what determines the amount of travel of the Box Pusher and Feed Ram Gates?
4. What 3 limit switches are associated with the Box Pusher and Kiln Feed Rams?
5. How and where is automatic or manual operation of the SWF selected?
6. How is casual entry prevented to the Box Lift?

7. What are the automatic functions for the following alarms:
    - Flame in Ram Feed Enclosure
    - Low Purge Flow
    - High Ram Feed Housing Temperature
    - Low Ram Feed Housing Pressure
    - Low Hydraulic Pressure
8. What are 9 DCS inputs which will cause Solid Waste Feed Shutdown?
9. What must the operator do to allow push-button operation of Solid Waste Feed system components? Which components can be operated by push-button from the local panel?

SYSTEM INTERRELATIONS

ELO 1.3	**Briefly EXPLAIN the consequences of a failure of the Solid Waste Feed System to fulfill it's intended purpose, including the effects on other systems or components and overall plant operation.**

Purge Air

The Purge Air System is used to prevent a buildup of potentially explosive combustion gases in the Box Pusher and Feed Ram housings. The Purge Air will be automatically isolated if a fire is detected in the feed ram housing, or a high temperature alarm in the feed ram housing is received. A failure of the Purge Air System would create hazardous conditions in the housing as the combustion gases may not be removed. A failure of the SWF system would not have an effect on the purge air system.

DCS

The DCS is used to provide coordinated control of the solid waste feed rate. SWF instrumentation and control devices provide input into DCS to allow sequencing of the rams, gates, and conveyors. A failure of the SWF system instrumentation could result in the failure of the DCS to properly control the sequencing and the ability to operate the SWF system. A failure of DCS would prevent the operation of the SWF system in the automatic mode, however manual operation of the system could continue.

Process Water

The Process Water System supplies cooling water for the hydraulic system heat exchanger which is used to cool hydraulic fluid recirculating in the system. A loss of cooling water to the heat exchanger would most likely result in a high hydraulic fluid temperature and possible shutdown of the SWF system. A failure of the SWF system would have no effect on the process water system.

Solid Waste Handling (SWH) System

The SWH System delivers a programmed and controlled amount of containerized waste materials to the SWF System for incineration. Changes or upsets in the SWH System will affect the amount of containers that may be delivered to the Solid Waste Feed System and the Incinerator. A failure of the SWF system will prevent the Solid Waste Handling System from processing boxes once the storage capacity of the storage conveyors has been reached.

Offgas System Quench Vessel

The quench vessel is used to maintain a negative pressure in the SWF housings to prevent the

leakage of combustion gases and contaminants from the housings to the atmosphere. The isolation valve in the feed ram housing vent is interlocked so that it will close when the fire door opens. This is done to prevent backflow of hot combustion gases from the kiln through the feed ram housing to the quench vessel. A failure of the quench system would prevent negative pressure from being maintained in the SWF housings which provides the potential for leakage out of the system rather than in. A failure of the SWF system would not affect the quench vessel.

Instrument Air System

Instrument Air is provided as seal air to the Box Pusher and Feed Ram Gate seals. A failure of instrument air to properly inflate the gate seals could result in the leakage of gases from the housings. A failure to properly deflate the seals could result in damage to the seals due to contact with a moving gate. A failure of the SWF system would not affect the operation of the Instrument Air System.

Nitrogen System

The Nitrogen System provides bottled nitrogen for suppression of flames or high temperature in he Feed Ram Housing. The nitrogen feed is initiated by the operator depressing the nitrogen push-button which will release nitrogen into the feed ram housing for a timed period and then shut off. If the flame continues, the operator will repeat the procedure until the flame is extinguished or the nitrogen is depleted. Failure of the nitrogen system would result in a loss of ability to extinguish a fire should one occur in the Feed Ram Housing. A failure (other than a fire) in the SWF system would not affect the Nitrogen System.

Incinerator

If the Solid Waste System fails to operate properly or is secured, this would result in the inability to process solid waste. This does not prevent the burning of liquid waste however, which can continue at the discretion of the Shift Supervisor

Review Questions

1. How is purge air affected if a flame is detected in the Ram Feed Housing?
2. How would the loss of Process Water affect the operation of the SWF system?
3. What is the interlock between the Kiln Feed Fire Door and the housing vent? What is the purpose of this interlock?
4. How does failure of the Solid Waste Feed System affect incinerator operations?
5. (Refer to drawing #W835589) The purge fan has 3 connections to the SWF system. 2 are to the Box Pusher housing and Ram Feed housing. Where does the 3rd connection go to?

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INTEGRATED PLANT OPERATIONS

ELO 4.1	**STATE the personnel safety concerns associated with the Solid Waste Feed System.**

Safety

1. Beware of pinch points while handling boxes and working around conveyors.
2. Use proper work gloves (e.g. leather) when handling boxes.
3. Follow safety practices as required in Manual 8Q, Employee Safety Manual.

ELO 4.3	**Given applicable procedures and plant conditions, DETERMINE the actions necessary to perform the following Solid Waste Feed System operations:** **a. Startup** **b. Manual Operation of Equipment** **c. Shutdown**

System Startup

Procedure 261-SOP-SWF-01, Solid Waste Feed Operations, is used to align the breakers, valves, DCS controls and alarms associated with the SWF System.

Once hydraulic level has been established ($\geq$ 1/4" in sightglass) the hydraulic pump may be started by the control room operator from the DCS Point Tag Display SWF6208E-1, SWF Hydraulic Control. An Operator should verify that hydraulic pressure at the accumulators is approximately 900-1000 psig on the hydraulic plant discharge pressure gage (H-261-SWF-PI-6207-B). The system integrity should then be verified by a walkdown of the Solid Waste Feed system the ensure all components are assembled, and verify the SWFS hydraulic system filter indicator is in the green (OK) range.

Position of all rams and gates should be verified as retracted/closed. If not in the proper position, manually position by operation of the appropriate button on the hydraulic control panel (H-261-SWF-PNL-6220). When the positions have been verified, the hydraulic control switch is then switched to automatic operation. Once the switch on the hydraulic control panel has been switched, the CRO should start the SWF hydraulic pump using the DCS point tag display SWF6208E-1. The operator should then notify the Shift Supervisor that the SWF system has been walked down and is ready for automatic operation.

Normal Operations

During normal operations, the Solid Waste Feed System is totally automatic. The Solid Feed System has an adjustable feed rate cycle frequency of 4 to 15 cycles per hour. Fuel oil flow is

adjusted as required to maintain RK exit temperature at an optimum design temperature 1600°F and SCC exit temperature of 1800F. Liquid waste and solid waste combustion air dampers will also be adjusted to maintain thermal efficiency. In the event that control of fuel oil flow and combustion air cannot maintain the required temperatures, the liquid waste flow and then solid waste feed flow rate will be adjusted. If temperature is still high, the tertiary air fan will then be operated to bring temperatures back into the required range.

System Shutdown

All waste streams going to the incinerator are autonomous as far as shutting down their individual feed systems and components. That is to say, the incinerator may be operated on solid waste, blended waste, aqueous waste, or radioactive organic waste or any combination of the wastes. Shutting down of a system is done in the event of temperature transients or when the waste supply is exhausted or stopped. The only exception to this concerns the fuel oil supply to the incinerator because the fuel oil will be modulated to control incinerator temperatures.

The Solid Waste Feed is stopped by shutting down the Hydraulic Power Unit (on DCS if the MOA selector switch is in AUTO or locally if the MOA selector switch is in OFF). The Purge Fan may be stopped when the RK exit gas temperature is less than 350°F.

ELO 2.3	**Given a description of abnormal equipment status for the Solid Waste Feed System, EXPLAIN the significance of the condition on system operation.**
ELO 2.4	**Given applicable procedures and a description of the Solid Waste Feed System equipment status, STATE any corrective actions required to return system operation to a normal condition.**

Abnormal Operations

Abnormal operation of the SWF System could be caused by failures of the Hydraulic System, Air Purge System, Service Water System, Fire Protection System, and the DCS/PLC/Instrumentation System and Door Closure.

Loss of Electrical Power

On a loss of electrical power a solenoid valve on the discharge side of the hydraulic accumulators will open and allow the accumulators to maintain the system pressure for the completion of one cycle of the kiln feed ram and the kiln feed fire door.

Loss of a Standby Diesel Generator

Whenever only one (1) Diesel Generator is available to the facility the SWF System must be shut down per the CIF SAR requirements.

Hydraulic System

Hydraulic System failure could be caused by an empty oil reservoir, pump or valve failure, loss of Process Water (cooling water), a hose fitting rupture or failure, DCS/PLC failure, or an accumulator failure. Any of these events would require a shutdown of the SWF System and may cause other accidents such as fires or explosions.

Air Purge System

Air Purge System failure could be caused by fan failure, damper failure, control valve failure, or failure of the DCS/PLC controls. Any of these events would require an incinerator shutdown and may cause other accidents such as fires or explosions.

Fire Protection System

A signal from the flame scanner or temperature indicator provides alarms so the operator can activate the Fire Protection (FP) System nitrogen snuffing, Nitrogen alarms will be displayed if the scanner detects a flame in the Feed Ram Housing or if high temperature (300F) is detected.

Fire Protection System failure could be caused by a nitrogen system failure. Failures associated with the nitrogen system include empty nitrogen bottle(s), valve failure, solenoid failure, pressure switch failure, or DCS/PLC failure. Depending upon the severity and the affected interlocks and controls, failures of the system could require an incinerator shutdown.

DCS/PLC

DCS/PLC failure could be caused by photoelectric eye failure, limit switch failure, or failure of DCS/PLC to respond to signals from local instrumentation. Depending upon the severity of the failure and the affected interlocks and controls, failures of the system could require an incinerator shutdown. Operator will respond to and mitigate events as required per the applicable abnormal operating procedure(s).

Mandatory Shutdown of an Individual Waste Burner

Any one of the liquid waste burners or the solid waste feed may be shut down during incinerator operation. If possible, changes to waste feed should be made slowly to allow operating burners to respond to transients. Multiple burner shutdowns should occur sequentially as opposed to simultaneously. In any case, incinerator temperatures should be closely monitored during and immediately after burner shutdowns.

- The following burners may be shut down without adverse effects to the incinerator:
- Aqueous Waste Feed to the RK (activation of the “RK AW STOP” control)
- Blended Waste Feed to the RK (activation of the “STEAM PURGE RK WL” control)
- Rad Organic Burner (activation of the “STEAM PURGE SCC RO” control)

Mandatory Shutdown of Solid Waste Feed

The Mandatory Shutdown of the Solid Waste system is accomplished by activation of the Hydraulic Power Unit control.

Review Questions

1. What are 2 safety concerns associated with the Solid Waste Feed System?
2. What must be checked in regard to the hydraulic plant on start-up?
3. Who normally starts the hydraulic pumps on start-up and how is this accomplished?
4. What are the manual operations for the Solid Waste Feed system the operator must perform during normal operations?
5. How is the Solid Waste Feed system normally secured and from where?
6. How would the loss of one standby diesel generator affect the Solid Waste Feed System?
7. What are 5 general possible causes of nitrogen system failure and how would this affect Solid Waste Feed System and Incinerator operations?

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REVIEW QUESTION ANSWERS BY CHAPTER

System Overview

1. To deliver containers to the RK incinerator in batch sequence while maintaining an airtight seal.
2. A batch of boxes is delivered by the box lift and travels through the Box Pusher Gate and is transported by the Box Pusher Conveyor to the Box Pusher Ram. The Box Pusher Ram then moves the boxes through the Feed Ram Gate to the Kiln Feed Ram. The Kiln Feed Ram then moves the boxes through the Kiln Feed Fire Door into the RK incinerator.
3. Hydraulic Pump #1 supplies the hydraulic accumulators. Hydraulic Pump #2 is the normal hydraulic supply for the Box Pusher Gate, Feed Ram Gate, Kiln Feed Fire Door, Box Pusher Ram, and the Feed Ram.
4. The accumulators can supply the Feed Ram and the Kiln Feed Fire Door with enough hydraulic fluid for one complete cycle.
5. Cooling for the hydraulic fluid is provided by Site Service Water and the cooling takes place in the heat exchanger provided on the hydraulic system.
6. Operational sequencing of the gates, gate seals, and housing pressure prevent release of gases, wastes, or contaminants
7. See block diagram page 18.
8. A Venturi type vacuum pump is used to deflate the seals prior to opening the gate to prevent abrasion on a partially open seal.

Major Components

1. The Box Pusher Gate opening size is 26" by 26". The two features of the gate are that the gate is tight fitting, and the gate is supplied with inflatable seals.
2. The Box Pusher Gate seals are deflated prior to opening of the gate and reinflated after the gate is closed. This is accomplished by supplying instrument air to the seals for inflation and using a vacuum pump to deflate the seals prior to opening.
3. The Box Lift Conveyor is a chain driven roller conveyor used to move boxes into the Box Pusher housing.
4. Gas buildup in the Box Pusher and Ram Feed housings are prevent by supplying the two chambers with purge air and the connection to the quench system provides a less than atmospheric pressure in the housings to ensure any leakage is into the housing, not out.
5. The Feed Ram Gate is sized to pass 3 24 inches cubed boxed side by side. The Box Pusher Gate is sized to pass boxes in single file.
6. The two hydraulic pumps are tandem driven pumps(driven by the same shaft) pumps supplied by the same motor.
7. The Box Lift Conveyor is power from MCC 2, and MCC 4 supplies power to the Box Pusher Conveyor and the hydraulic unit.
8. The Kiln Feed Ram is constructed with a 12 1/2 feet of travel to ensure boxes are pushed

into the incinerator. It is powered by 2 hydraulic cylinders mounted on top of one another with rods extending out in opposite directions.

Instrumentation

1. Indications are:
    - Control Power On
    - Kiln Feed Fire Door Open
    - Kiln Feed Fire Door Closed
    - Flame in Ram Feed Chamber
    - Hydraulic Unit Temperature
    - Hydraulic Manifold Temperature
2. Control functions are:
    - Conveyor operation when required
    - Box Lift operation
    - Cycle of isolation gates
3. A fire is detected by use of a flame detector and temperature sensor. Nitrogen gas is used to suppress the fire.

Controls, Interlocks, and Alarms

1. The 4 interlocks are:
    - Area downstream gate is at lower pressure than upstream
    - Feed Ram Gate is closed
    - Kiln Feed Fire Door is closed
    - Box Pusher Ram is in retracted position
2. The ram is interlocked to prevent extension unless the Feed Ram Gate is open.
3. The amount of travel of the gates are controlled by Limit Switches which determine the fully open and fully shut position.
4. The 3 switches are:
    - Fully extended
    - Fully retracted
    - Intermediate
5. By the position of the Manual-Off-Automatic (MOA) Stitch on the hydraulic control panel.
6. The door at ground level has a safety interlock which well energize a Door Open signal on DCS, sound an audible alarm, and stop the feed process.
7. Automatic functions are as follows:
    - Flame in Ram Feed Enclosure - incinerator shutdown
    - Low Purge Flow - incinerator shutdown

- High Ram Feed Housing Temperature - SWF system shutdown
- Low Ram Feed Housing Pressure - SWF system shutdown
- Low Hydraulic Pressure - SWF system shutdown

8. The inputs include:
    - Box Pusher or Feed Ram failure
    - Hydraulic pressure above or below specified limit
    - Hydraulic accumulator pressure below specified limit
    - Nitrogen snuffing pressure below specified limit
    - Photoelectric eye detects box stuck beneath Box Pusher Gate
    - Flame scanner detects flame in Feed Ram Housing
    - Temperature indicator detects high housing temperature
    - Ash Removal System failure on DCS
    - Incinerator or Secondary Combustion Chamber (SCC) exit temperature drops below LO-LO-LO Setpoint.
9. To allow push-button operation the operator must select the M-O-A switch to manual. Components which can be operated from the panel:
    - Box Pusher Gate
    - Box Pusher Ram
    - Feed Ram Gate
    - Kiln Feed Ram
    - Kiln Feed Fire Door

System Interrelations

1. Purge air is automatically isolated if a fire is detected in the Feed Ram Housing.
2. Process Water supplies the hydraulic system heat exchanger and would most likely result in a high hydraulic fluid temperature and require SWF shutdown.
3. The isolation valve in the housing vent closes when the Fire Door is open to prevent backflow of hot combustion gases to the quench vessel.
4. This would result in the inability to process solid waste, but the burning of liquid waste can continue at the discretion of the Shift Supervisor.
5. The 3rd purge air connection is to the flame scanner to provide cooling to the instrument.

Integrated Plant Operations

1. The 2 concerns are:
    - Beware of pinch points while handling boxes and working around conveyors.
    - Use proper work gloves when handling boxes.
2. Checks to be performed are:

- sump level
- accumulator pressure
- system integrity
- filter indicator

3. The hydraulic pumps are normally started by the Control Room Operator using the DCS point tag display.
4. None. During normal operations the Solid Waste Feed system is totally automatic.
5. The Solid Waste Feed system is secured by shutting down the Hydraulic Power Unit from DCS if the M-O-A switch is in Automatic, or locally if the M-O-A switch is in off or manual.
6. The Solid Waste Feed system must be shut down whenever only 1 Diesel Generator is available.
7. Causes are:
    - empty nitrogen bottles
    - valve failure
    - solenoid failure
    - pressure switch failure
    - DCS/PLC failure
    - Depending on the severity and the affected interlocks and controls, failure could require SWF and incinerator shutdown.